Building Research Establishment Digest

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Roof drainage: part 1

This digest is published in two parts: Part 1, Sizes for eaves gutters and downpipes, based on experimental data; Part 2, Sizes for valley and parapet gutters, outlets or receivers, and rainwater pipes, based on experimental data and theoretical studies.

The two parts together replace Digest 107 which is now withdrawn.

Design rate of rainfall

Roof drainage calculations can usually be based on a rate of rainfall of 75 mm/h. Short storms of higher intensity — 150 mm/h or more — do occur and should be assumed for situations where overflowing cannot be tolerated. Regional differences are more significant in relation to total rainfall than to intensities and can usually be ignored for the present purpose.

As an indication of the frequency of these intensities: 75 mm/h may occur for 5 minutes once in 4 years, or for 20 minutes once in 50 years.

150 mm/h may occur for 3 minutes once in 50 years, or for 4 minutes once in 100 years.

Sizes of eaves gutters and downpipes

Flow load

The rate of run-off from a roof is the product of the design rate of rainfall (usually 75 mm/h) and the effective roof area. (1 mm of rainfall on an area of 1 m^2 is 1 litre of water).

Information on the strength of the wind during periods of intense rainfall is sparse, but it is suggested in CP 308 that the angle of descent of wind-driven rain should be taken as one unit horizontal for every two units of descent (*see* Fig 1). This means that the effective roof area should be taken as the plan area plus half the elevation area — in Fig 1, (b + c/2) × length.

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Eaves gutters

Each eaves gutter should be designed for the wind direction that will give the maximum rate of flow in the gutter. In practice, it may be convenient to calculate the flow load per metre run of eaves.

A square angle within 4 m of an outlet will reduce the flow capacity of a gutter. This can be allowed for by multiplying the rate of run-off by one of the following factors, instead of adjusting the values for flow capacity of the gutter:

angle within 2 m of the outlet:
- — sharp-cornered × 1.2
- — round-cornered × 1.1

angle within 2-4 m of the outlet:
- — sharp-cornered × 1.1
- — round-cornered × 1.05

Table 1 gives flow capacities for level gutters, of half-round, segmental and ogee section, with outlet at one end. The flow capacities of gutters of other profiles and sizes can be calculated from the formula given in Part 2.

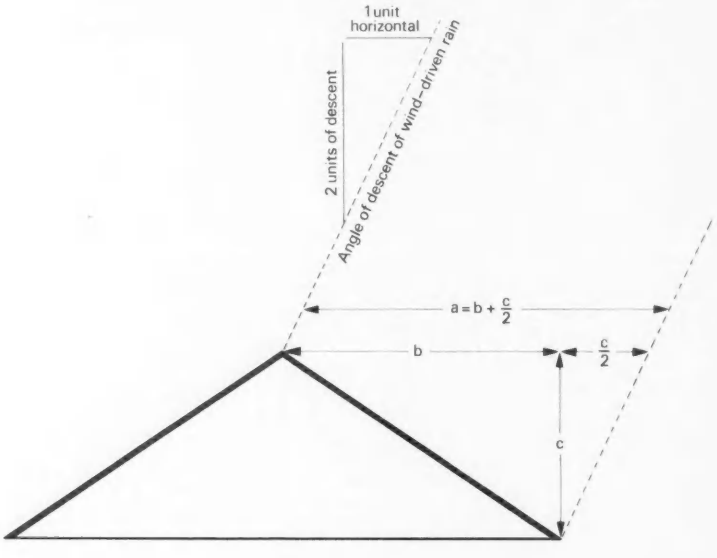


Fig 1 Effective roof area

Table 1 Flow capacities (litres/second) of level gutters with outlet at one end

Nominal gutter size *mm*	True half-round gutter (1, 2, 5)	Nominal half-round (segmental) gutter (3, 4, 5)	Ogee gutter (2)	Ogee gutter (3, 4)
75	0.4	0.3	—	—
100	0.8	0.7	0.9	0.5
115	1.1	0.8	1.4	0.7
125	1.5	1.1	1.7	0.8
150	2.3	1.8	2.6	—

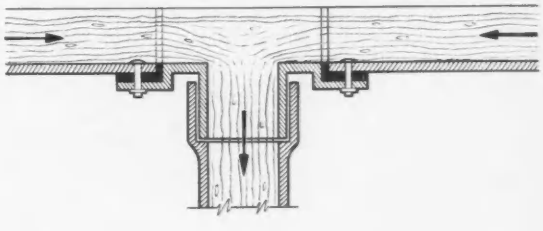
1 Asbestos-cement to BS 569: 1973
2 Pressed steel to BS 1091: 1963
3 Aluminium to BS 2997: 1958
4 Cast iron to BS 460: 1964
5 Unplasticised pvc to BS 4576: Pt 1: 1970

The effective area of roof (in m^2) drained by level eaves gutters with outlet at one end, at a rate of rainfall of 75 mm/h, can be found by multiplying the flow capacities given in Table 1 by 48. For other rates of rainfall, the areas will be inversely proportional.

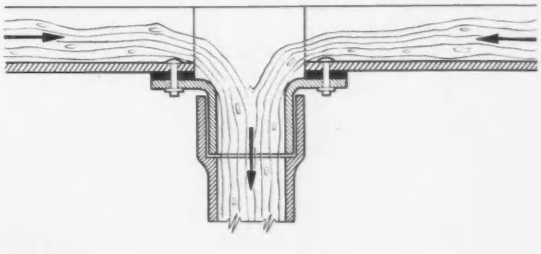
Downpipe sizes appropriate to stated gutter sizes are listed in Table 2. Figures are given both for sharp and round-cornered outlets (see Fig 2). The table allows also for the position of the outlet in relation to the end of the gutter.

Table 2 Minimum downpipe sizes (nominal dia in mm) for various gutter sizes

HR gutter size	Sharp or round-cornered outlet	Outlet at end of gutter	Outlet not at end of gutter
75	sc	50	50
	rc	50	50
100	sc	63	63
	rc	50	50
115	sc	63	75
	rc	50	63
125	sc	75	89
	rc	63	75
150	sc	89	100
	rc	75	100



(a) sharp-cornered outlet



(b) round-cornered outlet

Fig 2 Outlets receiving flow from two directions

Example 1 *Calculate the sizes of eaves gutter and downpipes required to drain a roof 40 m long × 10 m (ridge to eaves) 30° pitch.*

First calculate the effective roof area per metre run of eaves. By calculation, or measurement from drawings, plan length ridge-to-eaves is 8.65 m; the height is 5 m.

$$\text{Plan length + half the height} = 8.65 + \frac{5.0}{2} = 11.15 \text{ m.}$$

The effective roof area is thus 11.15 m^2 per m of eaves.

With rainfall at 75 mm/h (1.25 1/min m^2) the rate of run off will be

$$11.15 \times 1.25 = 13.94 \text{ 1/min}$$
$$= 0.23 \text{ 1/s}$$

From Table 1, a 125 mm (nominal) true half-round gutter could cope with the flow from a length of eaves of $\frac{1.5}{0.23} = 6.5$ m

Alternatively, a 150 mm (nominal) true half-round gutter could cope with the flow from a length of eaves of $\frac{2.3}{0.23} = 10$ m

Outlets would be needed at not more than double these distances apart, viz 13 m or 20 m for the two sizes of gutter, respectively.

Two possible solutions are shown in Fig 3: the roof could be drained (a) by a 125 mm true half-round gutter and three 75 mm diameter downpipes, or (b) by a 150 mm true half-round.gutter and two 100 mm diameter downpipes. The downpipe sizes are read from Table 2 and assume the use of round-cornered outlets.

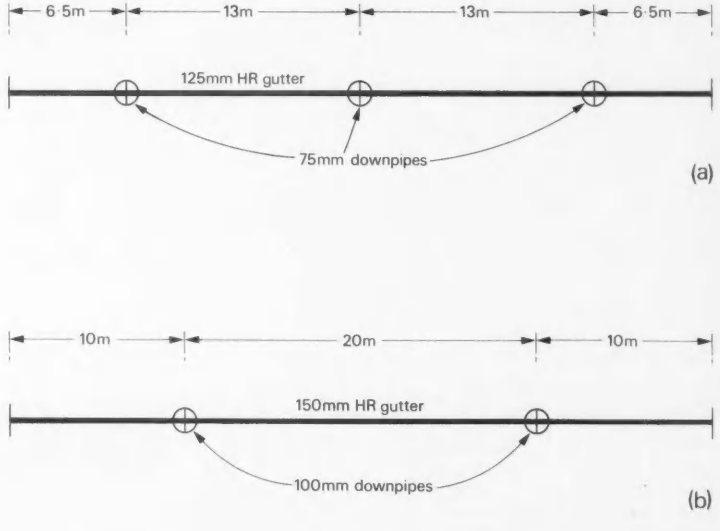


Fig 3

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